

Amendments to the Claims

Claim 1 has been amended to replace “phosphonic acids” with “di-phosphonic acids, tri-phosphonic acids, poly-phosphonic acids, phosphonoacetic acids” thereby incorporating the features of claim 7, to replace “amines” with “aminoethylethanolamine” and “polyethyleneimine” thereby incorporating the features of claim 14, and to remove “thiols” from the list of polishing additives. Accordingly, claims 7 and 10-14 have been cancelled, and claims 8, 9, and 16 have been amended with respect to claim dependency. Claim 1 has also been amended to recite the requirement for “at least one passivation film-forming agent,” thereby incorporating the feature of original claim 24. Claims 8 and 16 have been amended to refer to the passivation film-forming agent recited in amended claim 1. Claim 24 has been amended to recite that the passivation film-forming agent is selected from a particular group and is supported by the specification at page 11, lines 10-14. Claims 36-39 have been cancelled as they are directed to a non-elected invention.

No new matter has been added by way of these amendments. The precise amendments to the claims, as well as the pending claims as amended, are set forth on separate attachments hereto.

Summary of the Office Action

Claims 1, 3-6, 8, 10-13, 15-18, 20-27, 33, and 35 stand rejected under 35 U.S.C. § 103(a) as obvious over Sasaki (i.e., U.S. Patent 5,770,095). Claims 7, 9, and 19 stand rejected under 35 U.S.C. § 103(a) as obvious over Sasaki in combination with Kaufman (i.e., U.S. Patent 5,783,489). Claim 14 stands rejected under 35 U.S.C. § 103(a) as obvious over Sasaki in combination with Kaufman and Romberger (i.e., U.S. Patent 5,230,833). Claim 34 stands rejected under 35 U.S.C. § 103(a) as obvious over Sasaki in combination with Kaufman, Romberger, and Prigge (i.e., U.S. Patent 4,968,381).

Discussion of the Obviousness Rejection

The obviousness rejection of claims 1, 3-6, 8, 10-13, 15-18, 20-27, and 35 is moot in view of the amendments to the claims as discussed below with respect to each of the cited references. The obviousness rejection of claim 14 in view of Sasaki, Kaufman, and Romberger is moot in view of the cancellation of that claim. The obviousness rejection of claims 33 and 34 is respectfully traversed. Rejected claims 33 and 34 are based upon an allowed base claim, i.e., claim 32, thus the rejections of those claims is improper. Accordingly, the rejection of claims 33 and 34 should be withdrawn.

A. Obviousness in view of Sasaki

Sasaki does not disclose a system for polishing a substrate comprising a polishing additive selected from the group consisting of pyrophosphates, condensed phosphates, diphosphonic acids, tri-phosphonic acids, poly-phosphonic acids, phosphonoacetic acids and salts thereof, aminoethylethanolamine, polyethyleneimine, amino alcohols, amides, imines, imino acids, nitriles, nitros, thioesters, thioethers, carbothiolic acids, carbothionic acids, thiocarboxylic acids, thiosalicylic acids, and mixtures thereof, as recited in the pending claims. Rather, Sasaki discloses a polishing composition comprising ethylenediamine, amino acids containing sulfur, and thiols such as phosphonic acids. The only phosphonic acid disclosed is octanephosphonic acid, which is a mono-phosphonic acid.

Moreover, there is nothing in Sasaki that teaches or suggests that the mono-phosphonic acid could be replaced with diphosphonic acids, tri-phosphonic acids, poly-phosphonic acids, phosphonoacetic acids and salts thereof, as recited in the pending claims. Sasaki discloses that phosphonic acids, such as octanephosphonic acids, are useful for forming protective films on metal surfaces and act to suppress the removal rate of the substrate layer. Sasaki et al. teaches that the chemical agents to be used for forming such protective films preferably have a hydrophobic portion, such as a long alkyl chain as in octanephosphonic acid. Taken together, these teachings are contrary to the invention as recited in the pending claims. Applicants have surprisingly discovered that diphosphonic acids, tri-phosphonic acids, poly-phosphonic acids, phosphonoacetic acids and salts thereof can act as polishing additives that *increase the removal rate* at which the polishing system polishes the substrate metal layer. These classes of phosphonic acid compounds contain multiple phosphonic acid groups and do not contain any hydrophobic moieties, thus such phosphonic acid compounds are not suitable as film forming agents as taught by Sasaki.

Since Sasaki fails to teach or reasonably suggest the use of any of these polishing additives, the invention, as recited in the pending claims as amended, cannot properly be considered obvious over Sasaki.

B. Obviousness in view of Kaufman

Although Kaufman does disclose phosphonic acids, including aminotri(methylenephosphonic) acid, 1-hydroxyethylidene-4-diphosphonic acid, hexamethylenediaminetetramethylene phosphonic acid, and diethylenetetramine pentamethylenephosphonic acid, as stabilizers for polishing slurries, Kaufman does not teach or suggest the use of such phosphonic acids as polishing rate enhancers, as recited in the pending claims. Moreover, Kaufman does not disclose the use of a passivation film-forming agent or even recognize the importance of including a passivation film-forming agent.

Since Kaufman fails to teach or reasonably suggest the use of phosphonic acids as polishing rate enhancers and does not disclose a passivation film-forming agent, an essential element recited in the pending claims as amended, the invention cannot properly be considered obvious over Kaufman.

C. Obviousness in View of the Combination of Sasaki and Kaufman

There is nothing in either Sasaki or Kaufman that suggests their combination, let alone in the manner necessary to arrive at the present invention. As discussed above, Sasaki teaches the use of a mono-phosphonic acid having a hydrophobic long chain alkyl as a chemical agent, which forms a protective film on a metal layer of the substrate and acts to suppress the removal rate of the metal layer. Contrastingly, Kaufman teaches the use of polyphosphonic acids for use in stabilizing the polishing slurry against settling, flocculation, and decomposition. There is nothing in either Sasaki or Kaufman that teaches or suggests that a compound known to be useful as a stabilizer for a polishing slurry could also be useful as an agent for forming a passivation film on a metal layer of a substrate. Indeed, Sasaki teaches against the use of such polyphosphonic acids by teaching that the film-forming chemical agents are preferably hydrophobic.

Moreover, one of ordinary skill in the art would have no reasonable expectation of success that substituting the hydrophobic monophosphonic acid of Sasaki with a polyphosphonic acid of Kaufman would produce a polishing slurry that could have an increased rate of substrate removal, as recited in the pending claims, since neither Sasaki nor Kaufman even suggest the use of phosphonic acids for that purpose.

Absent any teaching or suggestion to combine Sasaki and Kaufman, the invention as recited in the pending claims as amended cannot properly be considered obvious over their combination.

D. Obviousness in view of Romberger

Romberger fails to satisfy the deficiencies of Sasaki and/or Kaufman as discussed above. Romberger discloses a colloidal silica slurry for use in the polishing of silicon substrates. Romberger neither discloses nor suggests any of the polishing additives recited by the pending claims or the use of a passivation film-forming agent. Accordingly, the cited references, alone or in combination, fail to render obvious the invention as recited by the pending claims.

E. Obviousness Rejection in view of Prigge


Prigge fails to satisfy the deficiencies of Sasaki, Kaufman, and/or Romberger as discussed above. Prigge discloses a process for reducing haze when polishing semiconductor, in particular, silicon substrates. Prigge neither discloses nor suggests any of the polishing additives recited by the pending claims or the use of a passivation film-forming agent. Accordingly, the cited references, alone or in combination, fail to render obvious the invention as recited by the pending claims.

In view of the forgoing, Applicants' claimed invention is not *prima facie* obvious in view of the cited references. Specifically, the cited references, alone or in combination, do not disclose or reasonably suggest the invention as defined by the pending claims. Therefore, the claimed invention is patentable over the cited references, and the obviousness rejection should be withdrawn.

Conclusion

The application is considered in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,



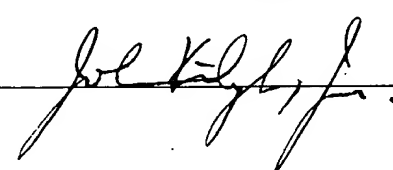
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Date: August 12, 2002

CERTIFICATE OF MAILING

I hereby certify that this RESPONSE TO OFFICE ACTION (along with any documents referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, Box AF, Washington, D.C. 20231.

Date: August 12, 2002





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RESPONSE UNDER 37 CFR 1.116
EXPEDITED PROCEDURE
EXAMINING GROUP 1765

PATENT
Attorney Docket No. 98124x205487

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Wang et al.

Application No. 09/636,161

Filed: August 10, 2000

For: POLISHING SYSTEM AND
METHOD OF ITS USE

Art Unit: 1765

Examiner: Lynette T. Umez-Eronini

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TC 1700

AMENDMENTS TO CLAIMS MADE IN RESPONSE TO
OFFICE ACTION DATED JUNE 18, 2002

1. (Amended) A system for polishing one or more layers of a multi-layer substrate that includes a first metal layer and a second layer comprising (i) a liquid carrier, (ii) at least one oxidizing agent, (iii) at least one polishing additive that increases the rate at which the system polishes at least one layer of the substrate, wherein the polishing additive is selected from the group consisting of pyrophosphates, condensed phosphates, [phosphonic acids] diphosphonic acids, tri-phosphonic acids, poly-phosphonic acids, phosphonoacetic acids and salts thereof, [amines] aminoethylethanolamine, polyethyleneimine, amino alcohols, amides, imines, imino acids, nitriles, nitros, thioesters, thioethers, carbothiolic acids, carbothionic acids, thiocarboxylic acids, thiosalicylic acids, and mixtures thereof, [and] (iv) at least one passivation film forming agent, and (v) a polishing pad and/or an abrasive.

7. cancelled

8. (Amended) The system of [claim 7] claim 3, wherein at least one oxidizing agent is a peroxide, and [wherein the system further comprises] at least one passivation film forming agent [comprising] comprises one or more 5-6 member heterocyclic nitrogen-containing rings.

9. (Amended) The system of [claim 7] claim 3, wherein at least one polishing additive is selected from the group consisting of ethylene di-phosphonic acid, 1-hydroxyethylidene-1,1-di-phosphonic acid, and a mixture thereof.

10. cancelled

11. cancelled

12. cancelled

13. cancelled

14. cancelled

15. cancelled

16. (Amended) The system of [claim 13] claim 9, wherein at least one oxidizing agent is a peroxide, and [wherein the system further comprises] at least one passivation film forming agent [comprising] comprises one or more 5-6 member heterocyclic nitrogen-containing rings.

24. (Amended) The system of claim 3, wherein [the system further comprises] at least one passivation film-forming agent is selected from the group consisting of 1,2,3-triazole, 1,2,4-triazole, benzotriazole, benzimidazole, benzothiazole, and hydroxy-, amino-, imino-, carboxy-, mercapto-, nitro-, urea-, thiourea-, or alkyl-substituted derivatives thereof.

36. cancelled

37. cancelled

38. cancelled

39. cancelled



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Examiner: Lynette T. Umez-Eronini

For: POLISHING SYSTEM AND
METHOD OF ITS USE

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TC 1700

PENDING CLAIMS AFTER AMENDMENTS
MADE IN RESPONSE TO OFFICE ACTION DATED JUNE 18, 2002

1. A system for polishing one or more layers of a multi-layer substrate that includes a first metal layer and a second layer comprising (i) a liquid carrier, (ii) at least one oxidizing agent, (iii) at least one polishing additive that increases the rate at which the system polishes at least one layer of the substrate, wherein the polishing additive is selected from the group consisting of pyrophosphates, condensed phosphates, diphosphonic acids, tri-phosphonic acids, poly-phosphonic acids, phosphonoacetic acids, and salts thereof, aminoethylethanolamine, polyethyleneimine, amino alcohols, amides, imines, imino acids, nitriles, nitros, thioesters, thioethers, carbothiolic acids, carbothionic acids, thiocarboxylic acids, thiosalicylic acids, and mixtures thereof, (iv) at least one passivation film forming agent, and (v) a polishing pad and/or an abrasive
2. The system of claim 1, wherein the liquid carrier is a nonaqueous solvent.
3. The system of claim 1, wherein the liquid carrier is water.
4. The system of claim 3, wherein the system comprises an abrasive suspended in the liquid carrier.
5. The system of claim 3, wherein the abrasive is fixed on the polishing pad.

6. The system of claim 3, wherein no abrasive is present in the system, and the polishing pad is a non-abrasive pad.

8. The system of claim 3, wherein at least one oxidizing agent is a peroxide, and at least one passivation film forming agent comprises one or more 5-6 member heterocyclic nitrogen-containing rings.

9. The system of claim 3, wherein at least one polishing additive is selected from the group consisting of ethylene di-phosphonic acid, 1-hydroxyethylidene-1,1-di-phosphonic acid, and a mixture thereof.

16. The system of claim 9, wherein at least one oxidizing agent is a peroxide, and at least one passivation film forming agent comprises one or more 5-6 member heterocyclic nitrogen-containing rings.

17. The system of claim 3, wherein at least one polishing additive is both (a) a compound selected from the group consisting of pyrophosphates, condensed phosphates, phosphonic acids and salts thereof, and (b) a compound selected from the group consisting of amines, amino alcohols, amides, imines, imino acids, nitriles, and nitros.

18. The system of claim 3, wherein at least one polishing additive is both (a) a compound selected from the group consisting of amines, amino alcohols, amides, imines, imino acids, nitriles, and nitros, and (b) a compound selected from the group consisting of thioesters, and thioethers, carbothiolic acids, carbothionic acids, thiocarboxylic acids, and thiosalicylic acids.

19. The system of claim 17, wherein at least one polishing additive is selected from the group consisting of 2-aminoethyl phosphonic acid, amino(trimethylenephosphonic acid), diethylenetriaminepenta(methylenephosphonic acid), hexamethylenediaminetetra(methylene phosphonic acid), and mixtures thereof.

20. The system of claim 3, wherein the system further comprises a source of ammonia.

21. The system of claim 20, wherein the system comprises (i) aminotri-(methylenephosphonic acid) and (ii) ammonia or an ammonium salt.

22. The system of claim 3, wherein the system further comprises at least one stopping compound.

23. The system of claim 3, wherein the system further comprises at least one polymeric compound that reduces the polishing rate of at least one layer associated with the substrate.

24. The system of claim 3, wherein at least one passivation film-forming agent is selected from the group consisting of 1,2,3-triazole, 1,2,4-triazole, benzotriazole, benzimidazole, benzothiazole, and hydroxy-, amino-, imino-, carboxy-, mercapto-, nitro-, urea-, thiourea-, or alkyl-substituted derivatives thereof

25. The system of claim 3, wherein the abrasive is a metal oxide abrasive.

26. The system of claim 25, wherein the abrasive is selected from the group consisting of alumina, ceria, germania, silica, titania, zirconia, and coformed products thereof, and mixtures thereof.

27. The system of claim 26, wherein the abrasive is alumina.

32. The system of claim 1, wherein at least one polishing additive is iminodiacetic acid.

33. The system of claim 32, wherein the system further comprises at least one stopping compound.

34. The system of claim 32, wherein the system further comprises at least one polymeric compound that reduces the polishing rate of at least one layer associated with the substrate.

35. The system of claim 22, wherein the system further comprises ammonia or an ammonium salt.